Everglades, approximately 30 miles southeast of Fort Myers. The Fort Pierce Reservation is the most recent addition (1995), and occupies 50 acres in Florida's St. Lucie County. None of the Seminole Reservation lands are located in direct proximity to the Gulf of Mexico.

Louisiana

Tribes located in southern Louisiana are located in areas west of the areas that could be impacted by the activity under the proposed General Permit. The farthest east, the Chitimacha Tribe of Louisiana, maintains a reservation in the northern portion of St. Mary's parish, which is located on the central portion of Louisiana's Gulf coast.

3.5 CLIMATE CHANGE

The effect of ongoing human-caused climate change makes the Gulf of Mexico environment vulnerable to rising ocean temperatures, sea level rise, storm surge, ocean acidification, and significant habitat loss. Cores from corals, ocean sediments, ice records, and other indirect temperature measurements indicate the recent rapid increase of ocean temperature is the greatest that has occurred in at least the past millennium and can only be reproduced by climate models with the inclusion of human-caused sources of heat trapping gas emissions. While the long-term global sea surface temperature pattern is clear, there is considerable variability in the effects of climate change regionally and locally because oceanographic conditions are not uniform and are strongly influenced by natural climate fluctuations (Doney et al., 2014).

Certain areas along the Atlantic and Gulf of Mexico coasts are undergoing relatively rapid sea water inundation and associated landscape changes because of the prevalence of low-lying coastal lands in combination with altered hydrology and land subsidence. The combination of sea level rise and land subsidence is forecast to result in various changes in the distribution and abundance of coastal wetlands and mangroves, which could damage habitat functions for many important fish and shellfish populations (BOEM, 2016). Shellfish populations also are at risk from ocean acidification. Increases in water temperatures will alter the seasonal growth and geographic range of harmful algae and certain bacteria, such as *Vibrio parahaemolyticus,* which was responsible for human illnesses associated with oysters harvested from the Gulf of Mexico and northern Europe (Doney et al., 2014).

3.6 THE DEEPWATER HORIZON OIL EVENT AND POTENTIALLY AFFECTED ENVIRONMENTAL RESOURCES

The incident at the Deepwater Horizon drilling platform (Macondo-1 well) in April 2010 created the largest oil spill in the history of the U.S., releasing approximately 4.1 million bbl of crude oil into the Gulf of Mexico. After 87 days of flow, the well was capped in July 2010. The Macondo-1 wellsite is approximately 145 kilometers from the Louisiana coast, located southwest of the mouth of the Mississippi River. The wellsite is located in an area under the NPDES administrative jurisdiction of EPA Region 6, and is 32 kilometers from the administrative boundary of EPA Region 4. The bulk of the oil was released off the coast of Louisiana, but eventually oil spread east of the mouth of the Mississippi River along the Mississippi, Alabama, and Florida coastlines, reaching Panama City, Florida.

The oil spill and response represented a major event that had the potential to affect the environmental conditions in the area covered under the proposed General Permit. EPA Region 4 reviewed data and studies recently available on the impacts of the event on environmental resources and the potential for these impacts to change the environmental conditions of these

among eastern Gulf of Mexico counties potentially affected by the spill or in the expected area of impact from the proposed General Permit. As previously presented in sections of this EA covering commercial and recreational fishing, no information has been identified that documents either the Deepwater Horizon event or the discharges authorized under the proposed General Permit have had any demonstrable, long-term impact on the availability of seafood. Also, as previously discussed in the preceding section on Human Health, no information has been identified that documents either the Deepwater Horizon event or the discharges authorized under the proposed General Permit have had any demonstrable impact on seafood quality.

4.4.4.2 Permit Provisions to Minimize or Eliminate Potential Consequences

EPA Region 4 is proposing numerous permit provisions intended to avoid or minimize potential adverse impacts to seafood quality and on commercial and recreational fishing, including limiting water column and sediment toxicity; limiting the content of trace metal and organic pollutants associated with the liquid, suspended particulate, and solid phases of discharges; and prohibiting the discharge of free oil, foam, floating solids, trash, debris, and toxic pollutants at higher than trace (detectible) amounts. The provisions of the proposed General Permit that avoid or minimize adverse environmental justice impacts or human health effects are the same set of requirements that avoid and minimize potential adverse commercial and recreational fisheries impacts (see Sections 4.4.1 and 4.4.2).

4.4.4.3 Cumulative Impacts

Potential impacts to minority and low income populations residing in Gulf coastal counties of Mississippi, Alabama, and Florida primarily are related to human health impacts from eating contaminated seafood and the availability of seafood. Cumulative impacts on human health issues related to seafood safety have been discussed in previous sections on Human Health (Section 4.4.3) and on commercial and recreational fishing (Sections 4.4.1 and 4.4.2). Seafood availability has been discussed in the previous sections on commercial and recreational fishing (Sections 3.4.1 and 3.4.2).

There is no information indicating a need for altering the terms, conditions, or limitations of the proposed General Permit. The existing provisions of the proposed permit represent what EPA Region 4 considers a set of requirements that is highly protective of the marine resources of the Gulf of Mexico, including impacts to minority and low income populations.

With permit provisions in place, drilling fluids and cuttings, produced water, WTCW fluids, and miscellaneous and other discharges may result in unavoidable but negligible localized impacts on potentially exposed minority or low income populations.

4.5 GREENHOUSE GAS EMISSIONS

4.5.1 Information Reviewed

EPA Region 4 considered the information regarding greenhouse gas emissions and climate change included in earlier NEPA reviews (EPA 1998a) and new information regarding GHG emissions and climate change relevant to the reissuance of the proposed General Permit. BOEM's 2017-2022 Outer Continental Shelf Oil and Gas Leasing Draft Proposed Program includes projected oil and gas development activity and estimated GHG emissions for exploration and development activities for the Eastern and Central Planning Areas of the Gulf of Mexico (BOEM, 2015a). In addition, the Council on Environmental Quality's December 2014

revised draft guidance for federal agencies' consideration of GHG emissions and climate change impacts in NEPA outlines a framework for analysis of these issues.

4.5.2 Greenhouse Gas Emissions and Climate Change

The majority of the Eastern Gulf of Mexico Planning Area and a small portion of the Central Gulf of Mexico Planning Area are unavailable for leasing through FY 2022 pursuant to GOMESA. EPA Region 4 used the oil and gas exploration and development activity (see Table 1-3) and estimated GHG emissions projected by BOEM in the 2017-2022 Five-Year Plan (BOEM, 2015a) to estimate reasonably foreseeable oil and gas exploration and development activity covered by the proposed General Permit, as well as associated GHG emissions from that activity. There is limited production from leases in the Central Gulf of Mexico Planning Area, and as of June 2016, no production has occurred from leases in the Eastern Gulf of Mexico Planning Area. Therefore, expected emissions for new activity in the eastern portion of the Gulf would be mostly from exploration and development. However, emission rates for the potential emissions from exploration, development, production, transportation, refining and combustion of oil and gas, based on relevant life cycle emission factors, have been included as a reference. This information is disclosed to provide a better understanding of associated GHG emissions from offshore oil and gas activity more broadly for this area of the Gulf.

Estimated Exploration and Development Emissions

The potential GHG emissions based on exploration and development activity are related to the projected number of wells that will be drilled over the term of the proposed General Permit. The number of wells drilled is expected to be the same for all of the options considered; therefore, the estimated GHG emissions are expected to be the same for each alternative, absent consideration of marginal, well-specific, GHG reduction measures. To estimate the potential GHG emissions (calculated as $MMTCO_2e$) from exploration and development wells subject to the proposed General Permit, EPA prorated the portion of the Central Planning Area emissions from exploration and development wells projected for the area subject to the General Permit (5% of the Central Planning Area) and added these to BOEM's emissions estimate for the Eastern Planning Area to derive the total estimated GHG contribution for exploration and development over the five-year term of the permit. There is substantial uncertainty with regard to estimating the number of wells that will be drilled over the term of the permit. Thus, a range of estimates is included in Table 4-5.

Estimated Upstream, Midstream and Downstream Greenhouse Gas Emission Rates

There is no anticipated future production in the Eastern Planning Area during the proposed 5-year General Permit considering the areas are unavailable for leasing under GOMESA, EPA Region 4's historical experience with implementing the General Permit and CAA permits in the eastern Gulf, and that, as of June 2016, no production has occurred from leases in the Eastern Planning Area. However, existing production and the potential for future production is possible within the Central Planning Area subject to the proposed General Permit.

Using emission factors developed from applicable life cycle analyses tools, including Argonne National Laboratory's *Greenhouse Gases, Regulated Emissions and Energy Use in Transportation Model* (GREET), Stanford University's *Oil Production Greenhouse Gas Emissions Estimator* (OPGEE), and University of Calgary's *Petroleum Refinery Life Cycle*

Table 4-5. Estimated GHG Emissions for Exploration and Development Activities of the Proposed NPDES General Permit

	Low Estimate	Mid-Estimate	High Estimate
Central Planning Area exploration and development wells projected/lease sale (a)	383	565	746
10 lease sales, 2017-2022 (b)	3830	5650	7460
Central Planning Area GHG emissions/5-Year Plan, $MMTCO_2e$* (b)	209	226	233
GHG per well ($MMTCO_2e$)	0.06	0.04	0.03
Central Planning Area/General Permit estimated number exploration and development wells (a) for 10 lease sales, 2017- 2022 (b)	90	140	180
Central Planning Area General Permit Estimated GHG Emissions ($MMTCO_2e$)/5-Year Plan	5	6	6
Eastern Planning Area GHG Emission ($MMTCO_2e$)/ 5-Year Plan (b)	47	53	55
Total General Permit GHG Emissions ($MMTCO_2e$)/ 5-Year Plan	52	59	61
Total General Permit GHG Emissions ($MMTCO_2e$)/ Year	10	12	12

(a) See Table 1-3, BOEM, 2015b

(b) Source: BOEM, 2015a

* $MMTCO_2e$ = million metrics tons carbon dioxide equivalent

Inventory Model (PRELIM), EPA estimated GHG emission rates for oil and gas product transportation, refining, and combustion of downstream oil and gas. Tables 4-6 and 4-7 provide estimated GHG emission rates for oil and natural gas, respectively, based on oil and gas exploration and production activity information in BOEM's 2017-2022 Five-Year Plan, life cycle assessment assumptions from NETL's *Life Cycle Analysis of Natural Gas Extraction and Power Generation* (May 2014), and the models listed above, as a reference to provide better understanding of associated GHG emissions from offshore oil and gas development in this area of the Gulf. These estimates can serve as preliminary values with a significant potential for variability. For example, the NETL model used a 2014 emissions inventory. Updating the model using EPA's 2016 data for methane emissions from oil and gas systems could result in changes to these estimates.

These estimated emission rates can be used to estimate combined upstream, midstream, and downstream GHG emissions associated with production in specific areas of the Gulf or various production scenarios or time periods. These rates, for example, can be used to provide a rough estimate of emissions for the limited oil production in the area covered by the proposed General Permit. For 2014 and 2015, oil production was 1.7 and 1.8 million bbl, respectively (BSEE

2016). Using the GHG combined emission rate range from Table 4-6, an estimated mass emission range can be calculated as 848,000 to 950,000 metric tons of CO_2e per year.

Table 4-6. Estimated Upstream, Midstream and Downstream GHG Emission Rates for Oil

GHG Estimated Upstream, Midstream and Downstream Factors (per bbl of oil)	**Estimated Emission Rates** kg CO_2e/bbl
Exploration, development and production of oil [1]	17
Transportation of oil [2]	20
Oil refining stage, low estimate (light oil refining) - high estimate (heavy oil refining/coking) [3]	27 - 56
Combustion [3]	435
Combined Estimated range of upstream, midstream and downstream GHG emission rate for oil	499-528

[1] Based on mid-estimate of development for Unleased Undiscovered Economically Recoverable Resources (UUERR) in BOEM's 2017-2022 Draft Program Plan, Appendix B (2016)

[2] Assumptions based on: Argonne National Laboratory's GREET Life-Cycle Model , https://greet.es.anl.gov/ and Stanford University's OPGEE https://pangea.stanford.edu/researchgroups/eao/research/opgee-oil-production-greenhouse-gas-emissions-estimator

[3] Assumptions based on: University of Calgary's PRELIM Model http://www.ucalgary.ca/lcaost/prelim

Table 4-7. Estimated Upstream, Midstream and Downstream GHG Emission Rates for Natural Gas

GHG Estimated Upstream, Midstream and Downstream Factors (per Thousand Cubic Foot of Natural Gas; MCF)	**Estimated Emission Rates** kg CO2e/MCF
Upstream Offshore Exploration and Development - through initial onshore storage [1]	6.7
Midstream Transportation through final usage including general leakage during transportation [2]	2.9
Downstream Combustion [3]	54.5
Combined Estimated upstream, midstream and downstream GHG emissions for gas	64

[1] National Energy Technology Laboratory's Life Cycle Analysis of Natural Gas Extraction and Power Generation (May 2014) http://www.netl.doe.gov/energy-analyses/temp/NaturalGasandPowerLCAModelDocumentationNG%20Report_052914.pdf

[2] Argonne National Laboratory's GREET Model https://greet.es.anl.gov/

[3] EPA, 1995 https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf

U.S. Department of Energy life cycle GHG analyses of natural gas extraction estimate that, in general, offshore natural gas production has the lowest life cycle GHG emissions of any natural gas source (i.e. compared to onshore conventional production or unconventional production, such as shale, coal bed methane, or hydraulically fractured tight deposits). Offshore natural gas reservoirs have very high recovery rates, since they must be large in order to justify well completion and construction of production facilities, and conventional offshore reservoirs do not generally require significant preparation and stimulation. In addition, offshore operations place a significant emphasis on controlling methane emissions to reduce safety and risk mitigation (NETL 2011; 2014).

Climate Change Impacts and Potential Mitigation

Multiple lines of independent evidence confirm that human activities are the primary cause of the global warming of the past 50 years. The burning of coal, oil, and gas, and clearing of forests have increased the concentration of carbon dioxide in the atmosphere by more than 40% since the Industrial Revolution. Methane and nitrous oxide emissions from human activities add to the atmospheric burden of heat-trapping gases (Walsh et al., 2014). GHG emissions have global scale, long-lasting impacts. Past, ongoing, and future emissions have caused trends that are expected to continue, including increased temperatures, extreme weather, snow and ice melt, sea level rise, and ocean acidification (Walsh et al., 2014). The incremental estimated emissions associated with activities covered under the proposed General Permit will have incremental climate-forcing impacts, including incremental cumulative impacts.

Practicable mitigation measures for GHG emissions that can be considered as part of future exploration, development, and production activity include the use of energy efficient equipment and technology, and technologies that directly reduce methane emissions. Energy efficient technologies may include advanced combustion technologies, engines that have high efficiency, and power and load management of drilling engines to reduce excess power production and fuel use. Leak detection technologies (such as infrared cameras), reduction of cold vent methane emissions, and flaring rather than venting can be considered for reduction of methane emissions.